JP-08-95066

[Title of the Invention] METHOD AND APPARATUS FOR MANUFACTURING LIQUID CRYSTAL DISPLAY DEVICE

[Abstract]

[Object] To provide a method of uniformly dispersing spacers on a substrate by dropping a dispersion liquid, in which the spacers are mixed with a solvent, on a surface of the substrate and rotating the substrate,

[Solving Means] The substrate 6 is mounted on a rotatable stage 7. The dispersion liquid having the spacers 1 is dropped on the surface of the substrate via a container 3, a pipe 5, and a nozzle 4. Then, the substrate 6 is rotated. As a result, the spacers can be uniformly dispersed on the surface of the substrate 6. This method is also effective even in dispersing spacers having than 1μm or less, which were difficult to be uniformly dispersed in a conventional method.

[Claims]

[Claim 1] A method of manufacturing a liquid crystal display device, the method comprising:

spraying spacers mixed with a solvent on a substrate; and

rotating the substrate to evaporate the solvent and uniformly disperse the spacers on the substrate.

[Claim 2] A method of manufacturing a liquid crystal display device, the method comprising:

rotating a substrate at a high speed;

spraying spacers mixed with a solvent on the substrate; and

rotating the substrate to evaporate the solvent and uniformly disperse the spacers on the substrate.

[Claim 3] An apparatus for manufacturing a liquid crystal display device, the apparatus comprising a spacer dispersing unit having:

a rotatable stage for mounting the a substrate;

a nozzle for dropping a liquid, in which spacers are mixed with a solvent, on an upper portion of the stage; and

a container for storing the liquid, the container being connected to the nozzle.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a method of and an apparatus for manufacturing a liquid crystal display panel, and more particularly, to a process for dispersing spacer particles for retaining a height of a gap between upper and lower substrates of a liquid crystal panel within a predetermined distance.

[0002]

[Description of the Related Art]

Conventionally, as a method of dispersing spacers, there have been a dry dispersing type and a wet dispersing type. In the dry dispersing method, the spacer particles are dispersed while an inert gas is applied so that they are stacked on a substrate. In the wet dispersing method, the spacer particles are mixed with a solvent such as alcohol. Then, the mixed liquid is sprayed like fogs so that the particles are stacked on a substrate.

[0003]

[Problems to be Solved by the Invention]

In the dry dispersing method, the spacer particles are electrically charged so that they are apt to be cohered. Also, in the wet dispersing method, the spacer particles having a diameter smaller than several micrometers are also apt to be cohered. Further, they are cohered as soon as the solvent on the substrate is evaporated. As a result, the spacer particles can not be uniformly dispersed. This would badly affect gap accuracy and orientation of liquid crystal materials.

[0004]

In order to solve the aforementioned problems, the present invention provides a method of manufacturing a liquid crystal display panel with high accuracy by readily

and uniformly dispersing the spacer particles.

[0005]

[Means for Solving the Problems]

In order to achieve the aforementioned object, according to a first aspect of the present invention, there is provided a method of manufacturing a liquid crystal display device, the method comprising: spraying spacers mixed with a solvent on a substrate; and rotating the substrate to evaporate the solvent and uniformly disperse the spacers on the substrate.

[0006]

According to a second aspect of the present invention, there is provided a method of manufacturing a liquid crystal display device, the method comprising: rotating a substrate at a high speed; spraying spacers mixed with a solvent on the substrate; and rotating the substrate to evaporate the solvent and uniformly disperse the spacers on the substrate.

[0007]

According to a third aspect of the present invention, there is provided an apparatus for manufacturing a liquid crystal display device, the apparatus comprising a spacer dispersing unit having: a rotatable stage for mounting the a substrate; a nozzle for dropping a liquid, in which spacers are mixed with a solvent, on an upper portion of the stage; and a container for storing the liquid, the container being

connected to the nozzle.

[Operation]

[0008]

According to the present invention, a mixed dispersion liquid in which spacers are mixed with a solvent is sprayed on a surface of a substrate. The substrate on which the mixed dispersion liquid is sprayed is rotated at a high speed by using a spinner or the like. Otherwise, the mixed dispersion liquid is sprayed on the substrate while the substrate is rotated at a high speed. As a result, the spacer particles can be very readily and uniformly dispersed on the substrate. Therefore, it is possible to obtain a liquid crystal display device having high gap accuracy.

[0009]

[Description of the Embodiments]

The present invention will be further illustrated with examples below.

[Embodiments]

In the present invention, any solvent that does not badly affect an orientation film can be used. However, since the beads should not be cohered in the solvent, the solvent used in the present invention should have high polarity. In this sense, alcohol will be preferable and effective. While the solvent should be evaporated during the substrate is rotated, a density of the beads depends on

the time for dispensing the spacers if the solvent is excessively volatile. This may provide bad reproducibility in a display device. Therefore, a solvent used in the present invention preferably has a vapor pressure within a range of 3 through 50mmHg in an atmospheric temperature of the dispersing unit.

[0010]

According to the present invention, various shapes of spacers can be used. Also, there is no limitation to the size of the spacer. Even beads having a diameter of 1 μm or less used in a ferromagnetic liquid crystal display panel can be uniformly dispersed. Particularly, in this case, the present invention is very effective because there were areas where the particles were inevitably cohered in the conventional dry or wet dispersing method. In the present invention, there is no limitation to the size of the substrate. Even a large substrate having a diameter 100 or 200 inches can be used if it can be rotated at a rotating speed of 1000 or more cycles per a minute.

[0011]

Referring to Fig. 1, a spacer dispersing unit used in an apparatus for manufacturing a liquid crystal display panel according to the preset invention comprises a container 3 for storing a dispersion liquid 2 made by mixing spacers with a solvent; a nozzle 4 connected to the

container 3 through a pipe 5 for discharging the dispersion liquid; and a stage 7 disposed under the nozzle 4 for mounting and rotating the substrate 6. An ultrasonic generator (not shown) may be added to the container 3 to more effectively dispersing the spacers. For the nozzle 4, either a drop type or a spray type can be used. Preferably, a nozzle 4 using both types is adopted.

[0012]

Now, preferred embodiments of the present invention will be described in detail.

(Embodiment 1)

A ball type spacer of 5mg is prepared. The spacer is made of SiO_2 and has a diameter of 1.0 μm. Then, isobutyl alcohol of 50ml is added to it, and dispersed by using an ultrasonic method for an hour to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is mounted on a stage 4. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. The substrate on the stage 4 is rotated at a rotation speed of 3000 rpm for 30 seconds. As a result, the spacers are very uniformly dispersed with a density of $1000/mm^2$.

[0013]

Similarly, a second glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is prepared. On the second glass substrate, sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0014]

(Embodiment 2)

A ball type spacer of 5mg is prepared. The spacer is made of SiO_2 and has a diameter of 0.8 μm. Then, isopropyl alcohol of 50ml is added to it, and dispersed by using an ultrasonic method for an hour to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is mounted on a stage 4. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. The substrate on the stage 4 is rotated at a rotation speed of 6000 rpm for 30 seconds. As a result, the spacers are very uniformly dispersed with a density of $1000/mm^2$.

[0015]

Similarly, a second glass substrate having a size of

55mm×65mm×1.1mm on which an orientation process has been completed is prepared. On the second glass substrate, sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0016]

(Embodiment 3)

A ball type spacer of 2mg is prepared. The spacer is made of SiO_2 and has a diameter of 0.8 μm. Then, propanol of 50ml is added to it, and dispersed by using an ultrasonic method for two hours to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 500mm×500mm×5mm on which an orientation process has been completed is mounted on a stage 4. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. The substrate on the stage 4 is rotated at a rotation speed of 2000 rpm for 60 seconds. As a result, the spacers are very uniformly dispersed with a density of $300/mm^2$.

[0017]

Similarly, a second glass substrate having a size of 500mm×500mm×5mm on which an orientation process has been

completed is prepared. On the second glass substrate, sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0018]

(Embodiment 4)

A ball type spacer of 5mg is prepared. The spacer is made of SiO_2 and has a diameter of 1.5 μm. Then, 1-butanol of 50ml is added to it, and dispersed by using an ultrasonic method for an hour to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 100mm×100mm×1.5mm on which an orientation process has been completed is mounted on a stage 4. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. The substrate on the stage 4 is rotated at a rotation speed of 3000 rpm for 50 seconds. As a result, the spacers are very uniformly dispersed with a density of $1000/mm^2$.

[0019]

Similarly, a second glass substrate having a size of 100mm×100mm×1.5mm on which an orientation process has been completed is prepared. On the second glass substrate,

sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0020]

(Embodiment 5)

A ball type spacer of 5mg is prepared. The spacer is made of SiO_2 and has a diameter of 1.0 μm. Then, isobutyl alcohol of 50ml is added to it, and dispersed by using an ultrasonic method for an hour to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is mounted on a stage 4. The substrate on the stage 4 is rotated at a rotation speed of 3000 rpm for 30 seconds. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. Further, the substrate on the stage 4 is rotated at a rotation speed of 3000 rpm for 30 seconds. As a result, the spacers are very uniformly dispersed with a density of $1000/mm^2$.

[0021]

Similarly, a second glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is prepared. On the second glass substrate,

sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0022]

(Embodiment 6)

A ball type spacer of 5mg is prepared. The spacer is made of SiO_2 and has a diameter of 0.8μm. Then, isopropyl alcohol of 50ml is added to it, and dispersed by using an ultrasonic method for an hour to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is mounted on a stage 4. The substrate on the stage 4 is rotated at a rotation speed of 6000 rpm for 30 seconds. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. Further, the substrate on the stage 4 is rotated at a rotation speed of 6000 rpm for 30 seconds. As a result, the spacers are very uniformly dispersed with a density of $1000/mm^2$.

[0023]

Similarly, a second glass substrate having a size of 55mm×65mm×1.1mm on which an orientation process has been completed is prepared. On the second glass substrate,

sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0024]

(Embodiment 7)

A ball type spacer of 2mg is prepared. The spacer is made of SiO_2 and has a diameter of 0.8μm. Then, propanol of 50ml is added to it, and dispersed by using an ultrasonic method for two hours to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 500mm×500mm×5mm on which an orientation process has been completed is mounted on a stage 4. The substrate on the stage 4 is rotated at a rotation speed of 2000 rpm for 30 seconds. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. Further, the substrate on the stage 4 is rotated at a rotation speed of 2000 rpm for 60 seconds. As a result, the spacers are very uniformly dispersed with a density of $300/mm^2$.

[0025]

Similarly, a second glass substrate having a size of 500mm×500mm×5mm on which an orientation process has been completed is prepared. On the second glass substrate,

sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0026]

(Embodiment 8)

A ball type spacer of 5mg is prepared. The spacer is made of SiO_2 and has a diameter of 1.5μm. Then, 1-butanol of 50ml is added to it, and dispersed by using an ultrasonic method for an hour to prepare a mixed dispersion liquid. The mixed dispersion liquid is stored in a container 1. Subsequently, a first glass substrate having a size of 100mm×100mm×1.5mm on which an orientation process has been completed is mounted on a stage 4. The substrate on the stage 4 is rotated at a rotation speed of 3000 rpm for 30 seconds. Then, the mixed dispersion liquid is applied to the surface of the substrate through the nozzle 2. Further, the substrate on the stage 4 is rotated at a rotation speed of 3000 rpm for 50 seconds. As a result, the spacers are very uniformly dispersed with a density of $1000/mm^2$.

[0027]

Similarly, a second glass substrate having a size of 100mm×100mm×1.5mm on which an orientation process has been completed is prepared. On the second glass substrate,

sealant is printed. Then, the first glass substrate is boned with the second glass substrate, and a liquid crystal material is injected. As a result, it is possible to obtain a liquid crystal display panel having a uniform thickness between both substrates.

[0028]

[Advantages]

As described above, according to the present invention, spacers mixed with a solvent are sprayed on a substrate, and the substrate is rotated at a high speed. As a result, the solvent is evaporated, and the spacers are uniformly dispersed on the substrate. The method according to the present invention is very simple, but provides high reproducibility in a liquid crystal display device.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a schematic diagram illustrating a spacer dispersing unit of an apparatus for manufacturing a liquid crystal display panel according to an embodiment of the present invention.

[Reference Numerals]

1: SPACER

2: DISPERSION LIQUID

3: CONTAINER

4: NOZZLE

5: PIPE

6: SUBSTRATE

7: STAGE

9: SPINNER FOR ROTATING SUBSTRATE

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平8－95066

(43)公開日　平成８年(1996)４月12日

(51)Int.Cl.^{6}　識別記号　ＦＩ

G02F　1/1339　500

　　　1/13　101

審査請求　未請求　請求項の数３　ＯＬ　（全４頁）

(21)出願番号　特願平6－231030

(22)出願日　平成６年(1994)９月27日

(71)出願人　000005821

松下電器産業株式会社

大阪府門真市大字門真1006番地

(72)発明者　西山　和廣

大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　朝山　純子

大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　滝本　昭雄

大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　弁理士　小鍜治　明　（外２名）

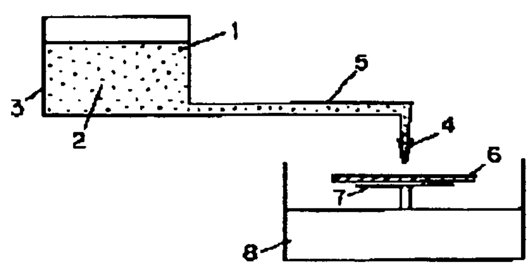
(54)【発明の名称】液晶素子の製造方法及びその装置

(57)【要約】

【目的】　基板表面にスペーサーの分散溶液を滴下し、基板を回転させることにより、基板表面に均一にスペーサーを分散することを目的とする。

【構成】　回転可能なステージ７に基板６を固定し、スペーサー１を分散した分散液２を容器３、連結管５、ノズル４を通って基板表面に滴下し、基板６を回転させることにより、基板６の表面に均一にスペーサー１を分散する。この分散方法は、従来難しかった１μｍ程度のスペーサーの散布にも非常に有効である。

1 スペーサ
2 分散液
3 容器
4 ノズル
5 連結管
6 基板
7 ステージ
8 基板回転装置



【特許請求の範囲】

【請求項1】溶媒中に分散したスペーサーを前記溶媒と共に基板上に塗布し前記基板を回転させ溶媒を蒸発させ、前記基板上に均一に前記スペーサーを分散させる工程を有することを特徴とした液晶素子の製造方法。

【請求項2】溶媒中に分散したスペーサーを前記溶媒と共に高速で回転させた基板上にスプレーした後、さらに基板を回転させ溶媒を蒸発させ、基板上に均一にスペーサーを分散させる工程を有することを特徴とした液晶素子の製造方法。

【請求項3】基板を固定し回転するステージと、前記ステージの上部に液体を滴下することができるノズルと、前記ノズルと連結したスペーサーを分散させた溶液を保持する容器とを備えたスペーサーの散布装置を有する液晶素子の製造装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、液晶を用いた液晶素子の製造方法、特に液晶パネルの基板間のギャップ厚を所定の距離で、均一に作製するためのスペーサー粒子の散布工程を有する液晶素子の製造方法及びその装置に関するものである。

【0002】

【従来の技術】従来のスペーサーの散布方法としては、乾式散布方法と湿式散布方法がある。従来の乾式散布方法とは、不活性気体を噴出させると同時にスペーサーを気体中に分散させ、基板上に堆積させる方法である。湿式散布方法は、スペーサーをアルコール等の溶媒に混合分散させた混合液を霧状にし基板に散布する方法である。

【0003】

【発明が解決しようとする課題】しかしながら従来の乾式散布方法では、スペーサーが帯電することによりスペーサーが凝集してしまう。また湿式方法では、同じく数μm以下の小さなスペーサーにおいては凝集しやすく、また基板上での溶媒が蒸発する時においても、凝集してしまう傾向があり、スペーサーが均一に分散されず、ギャップ精度が得られず、このスペーサーの凝集が配向乱れの原因ともなり問題とされてきた。

【0004】本発明は前記従来技術の課題を解決するために、非常に容易でかつ高度に均一にスペーサーを分散させ、ギャップ精度の優れた液晶素子の製造方法を提供することを目的とする。

【0005】

【課題を解決するための手段】前記目的を達成するために、本発明の第一のスペーサーの分散工程は、溶媒中に分散したスペーサーを前記溶媒と共に基板上に塗布し基板を回転させ溶媒を蒸発させ、前記基板上に均一にスペーサーを分散させることを特徴とする。

【0006】また、本発明の第二のスペーサーの分散工程は、溶媒中に分散したスペーサーを前記溶媒と共に、高速で回転させた基板上にスプレーした後、さらに基板を回転させ溶媒を蒸発させ、基板上に均一にスペーサーを分散させることを特徴とする。

【0007】さらに、本発明の液晶素子の製造装置は、基板を固定し回転することのできるステージと前記ステージの上部に液体を滴下することのできるノズルと、前記ノズルと連結したスペーサーを分散させた溶液を保持する容器とを具備していることを特徴とする。

【0008】

【作用】本発明によれば、あらかじめスペーサーを溶媒中に分散させておいた混合分散液を基板表面に塗布し、スピナー等を用いて基板を高速回転させるか、または、高速回転させている基板にスプレーすれば良いため、非常に容易でかつ高度に分散した状態のビーズ散布が可能であり、また、それにより、ギャップ精度の優れた液晶素子を製造することが可能となる。

【0009】

【実施例】本発明に用いる溶媒は配向膜に悪影響を与えるもの以外であれば何でもよいが、ビーズが溶媒中で凝集してはいけないことから、極性の高い溶媒が良い。そういう意味では最もアルコールが用い易い。また基板の回転中に溶媒が蒸発しないといけないこと、またあまりにも速く蒸発してしまうと分散液の塗布時間に分散濃度が大きく依存し、再現性が悪くなることから、散布場所の環境温度において、蒸気圧が3mmHg～50mmHgの溶媒が最も適している。

【0010】本発明に用いるスペーサーの形状には全く制限がない。また、スペーサーの大きさも制限がなく、強誘電性液晶素子に用いられる1μm程度のビーズであっても、非常に高度に分散可能である。特にこの場合、従来の湿式法や乾式法では、ビーズの凝集が避けられない領域であるため、本発明の分散法は非常に有効である。本発明で使用可能な基板の大きさは、1分間に1000回転以上回転させることができる基板であれば本発明の散布方法が使用可能なため、100インチや200インチのような大きな基板であっても可能である。

【0011】また本発明の液晶素子の製造装置に使用するスペーサーの分散装置は、図1に示すように、液体中にスペーサー1を分散させて調製した分散液2を保持しておく容器3とその分散液を取り出すためのノズル4が連結管5でつながっており、そのノズル4の下部には基板6を固定し回転させることのできるステージ7がある。容器3には超音波発生装置（図示せず）が取り付けてあればさらにスペーサーの分散性は向上する。またノズル4はスプレー噴射、滴下の両方可能なノズルが望ましい。

【0012】以下本発明の各実施例について説明する。

（実施例1）成分がSiO_2からなる直径1.0μmの球形のスペーサを5mgとりイソブチルアルコール50

ｍｌを加え、超音波で１時間拡散させ、混合分散液を調製しこれを容器１に入れる。次に、配向処理を施したガラス基板（５５mm×６５mm×１．１mm）をステージ４に設置し、先ほど調製した混合分散液をノズル２を通して基板表面に塗布し、３０００ｒｐｍで３０秒回転させる。すると約１０００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００１３】次に同じく配向処理を施したガラス基板（５５mm×６５mm×１．１mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られるものである。

【００１４】（実施例２）成分がSiO_2からなる直径０．８μmの球形のスペーサーを５ｍｇとりイソプロピルアルコール５０ｍｌを加え、超音波で１時間拡散させ、混合分散液を調製し容器１に入れる。次に、配向処理を施したガラス基板（５５mm×６５mm×１．１mm）をステージ４に設置し、先ほど調製した混合分散液を基板表面に塗布し、６０００ｒｐｍで３０秒回転させる。すると約１０００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００１５】次に同じく配向処理を施したガラス基板（５５mm×６５mm×１．１mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【００１６】（実施例３）成分がSiO_2からなる直径０．８μmの球形のスペーサーを２ｍｇとりプロピルアルコール５０ｍｌを加え、超音波で２時間拡散させて、混合分散液を調製し容器１に入れる。次に、配向処理を施したガラス基板（５００mm×５００mm×５mm）をステージ４に設置し、先ほど調製した混合分散液を基板表面に塗布し、２０００ｒｐｍで６０秒回転させる。すると約３００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００１７】次に同じく配向処理を施したガラス基板（５００mm×５００mm×５mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【００１８】（実施例４）成分がSiO_2からなる直径１．５μmの球形のスペーサーを５ｍｇとり１－ブタノール５０ｍｌを加え、超音波で１時間拡散させて、混合分散液を調製し、容器１に入れる。次に、配向処理を施したガラス基板（１００mm×１００mm×１．５mm）をステージ４に設置し、先ほど調製した混合分散液を基板表面に塗布し、３０００ｒｐｍで５０秒回転させる。すると約１０００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００１９】次に同じく配向処理を施したガラス基板（１００mm×１００mm×１．５mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【００２０】（実施例５）成分がSiO_2からなる直径１．０μmの球形のスペーサーを５ｍｇとりイソブチルアルコール５０ｍｌを加え、超音波で１時間拡散させ、混合分散液を調製しこれを容器１に入れる。次に、配向処理を施したガラス基板（５５mm×６５mm×１．１mm）をステージ４に設置し、３０００ｒｐｍで３０秒回転させ、先ほど調製した混合分散液をノズル２を通して基板表面にスプレー散布し、さらに３０００ｒｐｍで３０秒回転させる。すると約１０００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００２１】次に同じく配向処理を施したガラス基板（５５mm×６５mm×１．１mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【００２２】（実施例６）成分がSiO_2からなる直径０．８μmの球形のスペーサーを５ｍｇとりイソプロピルアルコール５０ｍｌを加え、超音波で１時間拡散させ、混合分散液を調製し容器１に入れる。次に、配向処理を施したガラス基板（５５mm×６５mm×１．１mm）をステージ４に設置し、６０００ｒｐｍで３０秒回転させ、先ほど調製した混合分散液を基板表面にスプレー散布し、さらに６０００ｒｐｍで３０秒回転させる。すると約１０００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００２３】次に同じく配向処理を施したガラス基板（５５mm×６５mm×１．１mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【００２４】（実施例７）成分がSiO_2からなる直径０．８μmの球形のスペーサーを２ｍｇとりプロピルアルコール５０ｍｌを加え、超音波で２時間拡散させ、混合分散液を調製し容器１に入れる。次に、配向処理を施したガラス基板（５００mm×５００mm×５mm）をステージ４に設置し、２０００ｒｐｍで３０秒回転させ、先ほど調製した混合分散液を基板表面にスプレー散布し、さらに２０００ｒｐｍで６０秒回転させる。すると約３００個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【００２５】次に同じく配向処理を施したガラス基板（５００mm×５００mm×５mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【００２６】（実施例８）成分がSiO_2からなる直径

1．5μmの球形のスペーサーを5mgとり1－ブタノール50mlを加え、超音波で1時間拡散させ、混合分散液を調製し容器1に入れる。次に、配向処理を施したガラス基板（100mm×100mm×1．5mm）をステージ4に設置し、3000rpmで30秒回転させ、先ほど調製した混合分散液を基板表面にスプレー散布し、さらに3000rpmで50秒回転させる。すると約1000個／mm^{2}の密度で非常に均一にスペーサーが分散できる。

【0027】次に同じく配向処理を施したガラス基板（100mm×100mm×1．5mm）に接着剤をシール印刷し、先ほどのスペーサーを分散させたガラス基板を貼合わせ液晶を注入すると、非常に基板間のギャップ厚が均一な液晶表示素子が得られる。

【0028】

【発明の効果】以上のように本発明は、溶液中に分散させたスペーサーを基板上に塗布し、基板を高速で回転させることにより、溶媒を蒸発させスペーサーを基板上に均一に散布させるため、スペーサーの散布としては非常に簡単であり、しかも高度に再現性良く分散させることが可能であるという特徴を有する。

【図面の簡単な説明】

【図1】本発明の一実施例の液晶素子の製造装置におけるスペーサー散布装置の概略図

【符号の説明】

1　スペーサー
2　分散液
3　容器
4　ノズル
5　連結管
6　基板
7　ステージ
8　基板回転装置

【図1】